GEOLOGIC COLUMN AND UNIT DESCRIPTIONS

AGE	ROCK UNIT	LITHOLOGY; THICKNESS WHERE KNOWN	REMARKS
SENOZOIC	Alluvium	Qal — *Sand, gravel, and clay; 2 meters to 7 meters*	Alluvium is composed of sand, gravel, and clay. In the basin of Sung-hua Chiang(松花江) placers of gold occur.
	Recent basalt	b3r — *Trachybasalt with olivine phenocrysts; 5 m to 10 m*	Flows of trachybasalt filled the recent valleys. Some phenocrysts of olivine are contained. The craters from which the lava flowed out are called by the natives "Lung-wan" (龍灣) meaning "Dragon Lake".
	Diluvium	Qdg — *Sand, gravel, and clay; about 10 m*	The diluvium is composed of sand, gravel, and clay. On the gently sloping basalt plateau about 40 km north-northwest of Fu-sung the diluvium contains a bed of diatomite from which fossil diatoms such as Navicula, Pinnularia, and Melosira are reported. The chemical composition of the diatomite is, SiO_2 82.41%, Al_2O_3 2.23%, Fe_2O_3 2.50%, ignition loss 5.23%.
	Pleistocene basalt	b_3 — *Trachybasalt with phenocrysts of olivine, pyroxene or labradorite; probably more than 200 m*	Trachybasalt forming wide-spread plateaus contain some phenocrysts of olivine, pyroxene, or labradorite. The basalt in the vicinity and east of Fu-sung is characteristically rich in feldspar phenocrysts, while in the basalt around Meng-chiang (孟江) olivine phenocrysts are predominant, suggesting that the two basalts may differ in origin or period of eruption. The basalt is commonly underlain by gravel and sand which are probably late Tertiary to early Quaternary.
	Neogene(?)beds	Tu — *Sand and gravel; 5 m to 10 m*	The unconsolidated beds of sand and gravel occasionally contain placer gold.
	Neogene(?) basalt	b_2 — *Trachybasalt with mafic minerals; probably more than 50 m*	Trachybasalt elevated 200 m above the surface of the surrounding Pleistocene basalt (b_3) is assigned to the Neogene. It is rich in mafic minerals (melabasaltic) compared with b_3 and b_3-r.
	?		
	Paleogene(?)beds	Ti — *Upper: sandstone and shale; 350 m or more. Lower: sandstone and basal conglomerate; about 300 m*	Upper: Beds of white, coarse-grained sandstone alternate with muddy shale, and are intercalated with several beds of oil shale, the thickest of which is 2 m on an average and yields 15-25% crude oil. The age is assigned to Eocene because of the occurrence of Planorbis pseudammonius Schlotheim, in addition to Fagus sp. and Quercus sp. Lower: Red sandstone with basal conglomerate unconformably overlies the andesite intruded into the Mesozoic coal-bearing beds.
	Unconformity		
MESOZOIC	Cretaceous granite	g_3 — *Hypabyssal granite and monzonite*	Granite and monzonite, mostly of hypabyssal-type, including granite porphyry, monzonite porphyry, and occasionally syenite porphyry. These intrusive rocks are believed to be of the same origin as the volcanic rocks near-by which have acidities corresponding to that of the granite and monzonite.
	Quartz porphyry	qp — *Quartz porphyry and rhyolite*	Quartz porphyry contains phenocrysts of sanidine and some albite; the groundmass is granophyric, microspherulitic or microfelsitic. Quartz porphyry is associated with rhyolite which has a devitrified groundmass showing flow structure. Distribution is closely related with that of the andesitic rocks of Mk-a.
	Gabbro	r_2 — *Diabasic gabbro*	The gabbro, including diabasic gabbro, shows a coarse ophitic texture composed of labradorite and diopsidic augite, and contains a small quantity of interstitial quartz. Locally the rock grades into monzonite. Unlike the Precambrian basic rocks (r_1), the rock shows neither saussuritization nor uralitization.
	Volcanic complex and sedimentary beds	Mka — *Andesite, trachyandesite, trachyte, agglomerate, tuff breccia* Mk — *Shale, sandstone, tuff; thickness 500 m. to 1,000 m*	Andesite, trachyandesite, and trachyte are associated with agglomerate and tuff breccia. Porphyrite in dikes intruded into the Jurassic coal-bearing formation (Mj) may belong to this volcanic complex. The Cretaceous sedimentary rocks include shale, sandstone, tuffaceous sandstone, and tuff. Their relation with the Jurassic formation is not always clear. No fossils helpful for age determination have been collected.
	Unconformity?		
	Jurassic coal-bearing beds	Mj — *Sandstone, shale, tuffaceous sandstone, and coal. Thickness about 1,000 m*	The Jurassic formation is composed of sandstone, shale, tuffaceous sandstone, and coal. Podozamites sp., Pityophyllum sp., and Phoenicopsis sp. are the common fossil plants. As at Fu-sung (撫松), the formation is occasionally interbedded with oil shale and black shale, and contains Esteria sp. The age of the coal-bearing beds is doubtful in Shan-sung-kang (杉松崗) (Sung-shan-kang (杉松崗)on the map) coal field where the Precambrian granite is thrust over the coal-bearing beds, and no fossils to determine age have been reported.
	Unconformity		
	Pre-Jurassic granite	g_2 — *Medium- to coarse-grained granite*	The granite is medium- to coarse-grained and contains oligoclase, orthoclase, quartz, biotite, and some microcline. Occasionally it may be a hornblende granite and is somewhat gneissose in places. The age of the intrusive is younger than Chilin formation and probably older than Jurassic.
	Intrusive contact		
PALEOZOIC	Chilin formation	Pu — *Shale, slate, limestone, breccia; always intruded by granite. Thickness probably 2000 m or more*	The Chilin formation is a Permo-Carboniferous formation of the North Manchurian type, mostly marine deposits. It is widely developed in the north of this map area (see Chi-lin sheet, NK 52-1); and is always intruded by granite. It consists chiefly of black shale, with phyllitic slate, limestone, and volcanic breccia. The base is not known. The limestone often contains crinoid stems; Syringopora sp. was collected from limestone north of Pan-shih, but fossils are generally fragmental and are not useful for age determination.
	Taitzuho system	Pu — *Sandstone, shale, coal, fire clay, limestone. Thickness 300 m to 500 m*	The Taitzuho system is a Permo-Carboniferous formation of the South Manchurian type, and mostly fresh-water deposits. The Upper part is composed of red sandstone and shale. The Middle part is gray sandstone and shale, coal-bearing beds intercalated with fire clays, and yields Annularia sp., Lepidodendron sp., and Stigmaria sp. The Lower part is green sandstone and sandy shale and contains thin beds of coal, fire clay, and limestone; this unit contains characteristic fauna of Moscovian or Middle Carboniferous and almost always rests on the Ordovician limestone disconformably.
	Disconformity		
	Ordovician formation	Plo — *Limestone, Cryptozoön limestone, and dolomite. Thickness more than 600 m*	Thick beds of dark gray limestone are associated with dolomite and cryptozoön limestone. Strophomena sp. and Dalmanella? sp. were collected near the coal fields of Shan-sung-kang and Sung-shu-chen(松樹鎮). The formation is generally conformable with the Cambrian, but in the southern region it sometimes rests unconformably on the Precambrian and Cambrian.
	Cambrian formation	Plc — *Shale, sandy shale, and oolitic limestone. Thickness about 500 m*	This Cambrian formation consists chiefly of reddish-purple shale, increasing in limestone in the upper part. Vermicular limestone and oölitic limestone are relatively scarce. Trilobites such as Solenoparia kuantungensis Endo and Lisania spinosa Endo are reported from the limestone near Fu-hsing-tun(復興屯) in the western region. Intricate folds and thrust faults are present.
	Disconformity		
PRECAMBRIAN	Sinian system	p€u — *Chiotou quartzite; Thickness less than 200 m* *Nanfen shale; thickness less than 2,000 m* *Tiaoyutai quartzite; thickness less than 500 m*	Upper (Chiatou quartzite):- Clayslate and quartzite with ripple marks and sun cracks constitute this unit. Thickness is variable. Middle (Nanfen shale):- Reddish-purple shale alternates with grayish-green shale and commonly are associated with green marl. Thickness is variable. Lower (Tiaoyutai quartzite):- Thick quartzite occurs almost always without argillaceous beds. Ripple marks occur occasionally. Thickness is variable.
	Unconformity		
	Pre-Sinian granite	g_1 — *Medium-grained granite*	The granite is mostly medium-grained and pink. It is characterized by an abundance of microcline and grades into pink granite gneiss. Locally it is distinctly intruded into gray gneiss or migmatitic gneiss, and forms intricate composite gneiss. Although the area of its distribution is extensive covering all the gneiss region, outcrops are too small to be mapped.
	Granite gneiss	ggn — *Gronite gneiss, quartz dioritic gneiss, and migmatitic gneiss*	Pink granite gneiss is intruded into gray quartz dioritic gneiss and gray migmatitic gneiss which are associated with one another. All these gneisses were subjected to mylonitization, locally exhibiting a marked "augen gneiss" structure, which is particularly notable in the northern region extending from Hui-nan(輝南) to Chia-pi-kou(夾皮溝) and farther east.
	Basic rocks	r — *Diorite, epidiorite, amphibolite, and amphibole schist*	Rocks range from intermediate to basic or ultra-basic rocks, including diorite, epidiorite, amphibolite, and amphibole schist. Massive rocks sometimes occur as distinct dikes in the gneisses (ggn), and schistose rocks occur commonly as schlierens which resemble sheets or xenoliths in appearance. The amphibolite, outcropping near Lao-chin-chang(老金廠), is associated with amphibololite and hypersthenite, and is intruded by the quartz diorite (gray gneiss of ggn).
	Intrusive contact		
	Liaoho system	p€m — *Chlorite schist, mica schist, dolomite, and iron. Thickness more than 3,000 m*	The formation consists chiefly of chlorite schist and mica schist; within the map area, carbonaceous rocks are few. It is distributed in the south and beyond the map area (see Lin-chiang sheet, NK 52-7), and in the northern districts occurs only as sparse xenoliths or bands in the gneisses. Remnants of iron ore beds are found in the gray gneisses east of Hui-nan and northeast of Lao-chin-chang. The iron ore northeast of Lao-chin-chang consists of chlorite, grünerite, magnetite, and quartz, and has about 35% Fe on an average. The iron ore much resembles the banded iron ore of the Anshan series at An-shan(鞍山), but these iron-bearing rocks are more gneissose suggesting they may be pre-Anshan. In fact, the rocks are intruded by the gneissose quartz diorite which may be correlated to the older Precambrian granite (tonalitic gneiss) unconformably underlying the Anshan series.

(COLUMN DRAWN NOT TO SCALE)

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